Arboviral Disease Surveillance — Kansas, 2014

Background

Arboviruses (arthropod-borne virus) are commonly spread to humans through the bites of infected mosquitoes, ticks, sand flies, or midges. This report focuses on those arboviruses transmitted by mosquitoes. West Nile virus is the leading cause of domestically acquired arboviral disease in the United States and Kansas[1]. West Nile virus was first identified in the United States in 1999 and spread throughout the United States. Natural transmission involves a mosquito-bird-mosquito cycle; animals such as humans and horses do not circulate enough virus to re-infect a blood-feeding mosquito, and thus are referred to as "dead-end" or "accidental" hosts. Several species of mosquitoes are responsible for transmission of arboviruses but *Culex* species are the primary vector for West Nile virus in the United States.

The incubation period for arboviral infections vary. The incubation period for West Nile virus ranges from 3 to 15 days with an average incubation period of approximately one week. Arboviral infections may be asymptomatic or may result in illness of variable severity. Approximately 80% of people who become infected with West Nile virus do not develop any symptoms[1]. About one in five people who are infected develop a fever with other symptoms such as headache, body aches, joint pains, vomiting, diarrhea, or rash[1]. Most people with West Nile virus Fever recover completely but fatigue and weakness can last for weeks or months[1]. Less than 1% of people who are infected develop a serious neurological illness, such as encephalitis or meningitis, and approximately 10% of people who develop this kind of an infection will die[1].

From 1999 – 2014 there were a total of 41,762 cases and 1,765 deaths in the United States from West Nile virus[2]. During 2012 the United States experienced and outbreak of West Nile virus that resulted in the second highest number of cases since 2002, with 5,674 cases reported to the Centers for Disease Control and Prevention (CDC)[2]. The number of cases declined sharply in 2013 with a 56.5% reduction in cases reported to CDC[2]. However, Kansas had a 63% increase in human cases in 2013. Cases continued to decline nationally in 2014 with an 11% reduction from 2013. Kansas had a substantial reduction in West Nile virus cases, 41%, from 2013 to 2014.

The Kansas Department of Health and Environment (KDHE) began surveillance for West Nile virus (WNV) in 2001 and the first human case was reported in Kansas in 2002. Mosquito surveillance was consolidated to Sedgwick County in 2013. This surveillance system has three main components: mosquito surveillance, human surveillance, and reporting the results to public health partners.

Methods

Mosquito Collection

Mosquito surveillance was conducted weekly from May 13 to October 21, 2014 by Dr. Christopher Rogers with the Kansas Biological Survey. Surveillance was conducted in Sedgwick County, where human cases have been reported most frequently in Kansas. Mosquito surveillance has been conducted solely in Sedgwick County since 2013. The traps were placed where mosquito arbovirus transmission was most likely to occur. These areas are where large numbers of migratory birds, extensive mosquito habitats, and large human populations coincide.

An Encephalitis Vector Survey (EVS) trap, with dry ice as a carbon dioxide source, was used to collect mosquitoes. These traps typically attract mosquitoes that feed on humans or other mammals. Nine traps were set each week in Sedgwick County. The traps were placed at the designated location in the early evening and were collected the following morning. The contents of the traps were secured

in a container and labeled with the address and GPS coordinates of the location of the trap. The mosquitoes were transported to the Kansas Biological Survey (KBS) at the University of Kansas for species identification.

Mosquito Identification

The KDHE contracted with the Kansas Biological Survey (KBS) to enumerate and identify mosquitoes to the species level. Mosquito counts of greater than 1,000 per trap were divided into a smaller subset for identification due to budget constraints. *Culex spp.*, the most common mosquito to transmit WNV, were submitted to the Kansas Health and Environmental Laboratories (KHEL) for testing. Results from the enumeration and identification were entered in a Microsoft® Excel® spreadsheet and submitted by KBS to KDHE weekly via e-mail.

West Nile Virus Testing of Mosquitoes

Mosquitoes of the genus *Culex*, the most common West Nile virus vector, were tested at the Kansas Health and Environmental Laboratories. Mosquitoes were divided into vials containing approximately 50 mosquitoes each and tested for West Nile virus by polymerase chain reaction (PCR). The results were entered in an Excel® spreadsheet and sent to KDHE. All results were posted to KDHE's website and reported to the ArboNET surveillance system. (ArboNET is a national arboviral surveillance system managed by the Centers for the Disease Control and Prevention (CDC) and state health departments.)

Human Case Surveillance

West Nile virus, and all other arboviral diseases, is a reportable disease in Kansas. It is a passive surveillance system; healthcare providers or laboratories are required to report cases to KDHE. Cases were classified according to the most recent CDC case definition (Appendix A). Confirmed and probable cases are reported to CDC and are included as the case count (e.g. confirmed + probable = total number of cases). It is important to note that these definitions are to be used for case counts only and are not used for clinical diagnosis. In addition, the county in which the person resides is used as the location for surveillance purposes, although they may have been infected elsewhere. Prior to 2011 Kansas only reported confirmed cases therefore we are only able to compare case counts and rates of West Nile virus from 2011-2014.

The cases were entered into EpiTrax, Kansas' electronic disease surveillance system, and the corresponding local health department completed investigation. The Arboviral Disease Investigation Guideline contains information to provide technical assistance with local surveillance and disease investigation. They contain not only disease-specific information, but also sample letters, reporting forms, sample communication sheets and other tools to assist the local public health department. Once the case investigation was complete, all confirmed and probable cases were reported to the ArboNET surveillance system and the results were posted to the ArboNET website. Information on human West Nile virus case counts and rates can be found in KDHE's annual publication, Reportable Infectious Diseases in Kansas.

We report the incidence rate (number of cases per 100,000 people) of West Nile virus neuroinvasive disease cases for Sedgwick County and compare it to the State of Kansas, the West North Central region (Iowa, Kansas Minnesota, Missouri, Nebraska, North Dakota, and South Dakota), and the United States. We limit our incidence rates to neuroinvasive disease cases as reporting for these cases are believed to be more consistent and complete than for non-neuroinvase disease cases[3].

Animal Case Surveillance

West Nile virus infection of animals is not a reportable disease in Kansas. However, positive laboratory results are sent to KDHE as a courtesy from the Kansas Department of Agriculture's Division of Animal Health and the United States Department of Agriculture's Animal and Plant Health Inspection Service. Horses may serve as a sentinel of West Nile virus activity in Kansas. Kansas does not conduct surveillance of dead birds for West Nile virus.

Mosquito Control

The Sedgwick County Health Department, City of Wichita, Sedgwick County Extension Office, and McConnell Air Force Base worked together in an effort to educate citizens, control mosquitoes, and decrease the risk of West Nile virus transmission in Sedgwick County. The Sedgwick County Health Department developed 'Fight the Bite' educational materials that highlighted the three 'D's of prevention; drain, dress, and DEET (Appendix B). Code Enforcement Officers with the Metropolitan Area Building and Construction Department (MABCD), distributed the 'Fight the Bite' palm cards to citizens as they conducted inspections throughout the city of Wichita and Sedgwick County. The Sedgwick County Extension Master Gardeners, Extension Agents, and the 22nd Medical Group Public Health staff at McConnell Air Force Base also distributed the palm cards. The following list contains examples of the public locations where the posters were displayed; neighborhood City Halls, libraries, swimming pools, recreation centers, golf courses, and city park restrooms.

The City of Wichita deployed mosquito larvicide 'dunks' to areas of standing water that were likely breeding locations for mosquitoes based on surveillance data. The 'dunks' were deployed in these areas when the *Culex spp.* mosquitoes were $\geq$20 per trap. The larvicide contained in the dunks is a type of bacteria, *Bacillus thuringiensis israelensis*, or Bti. When the Bti is eaten by mosquito larvae it prevents their development into adult mosquitoes. It is non-toxic to other insects, fish, animals, and humans. One dunk treats approximately 100 square feet of water and lasts up to 30 days.

Measures to Predict West Nile Virus Cases

The evaluation of the 2013 mosquito surveillance data indicated a strong correlation between the two-week mean *Culex spp.* prevalence and human cases that occurred in Sedgwick County and throughout the entire state of Kansas, three weeks later[4]. When the two-week mean number of *Culex* mosquitoes per trap was $\geq$44, 82% (9/11) of human WNV cases occurred three weeks later in Sedgwick County and 89% (81/91) of cases occurred three weeks later throughout the state of Kansas.[4]

We calculated the two-week mean *Culex spp*. prevalence and compared it to the number of human cases that occurred throughout the entire state for 2014. The two-week mean is calculated by counting the number female *Culex spp.* per trap for the current week of surveillance and the previous week and dividing by the number of traps during the same two weeks. There was only one case of West Nile virus in Sedgwick County during 2014 therefore we did not compare the two-week mean *Culex spp.* prevalence. In addition we combined data from 2013 and 2014 to increase sample size and to evaluate trends over time. The mean number of *Culex spp*. by two-week prevalence was compared to human cases that occurred at weekly intervals 2, 3, and 4 weeks later. The correlation between measures was calculated using Pearson's correlation coefficient (R) and a p-value of <0.05 was considered statistically significant.

The Vector Index (VI) can be used to quantify potential risk of transmission of West Nile virus from mosquitoes to humans[5]. The VI requires three values to complete the calculation; female vector mosquito presence, vector species density, and vector species infection rate[5]. There was only one WNV positive mosquito pool in 2014 therefore we did not calculate the VI.

Results

Mosquito Surveillance

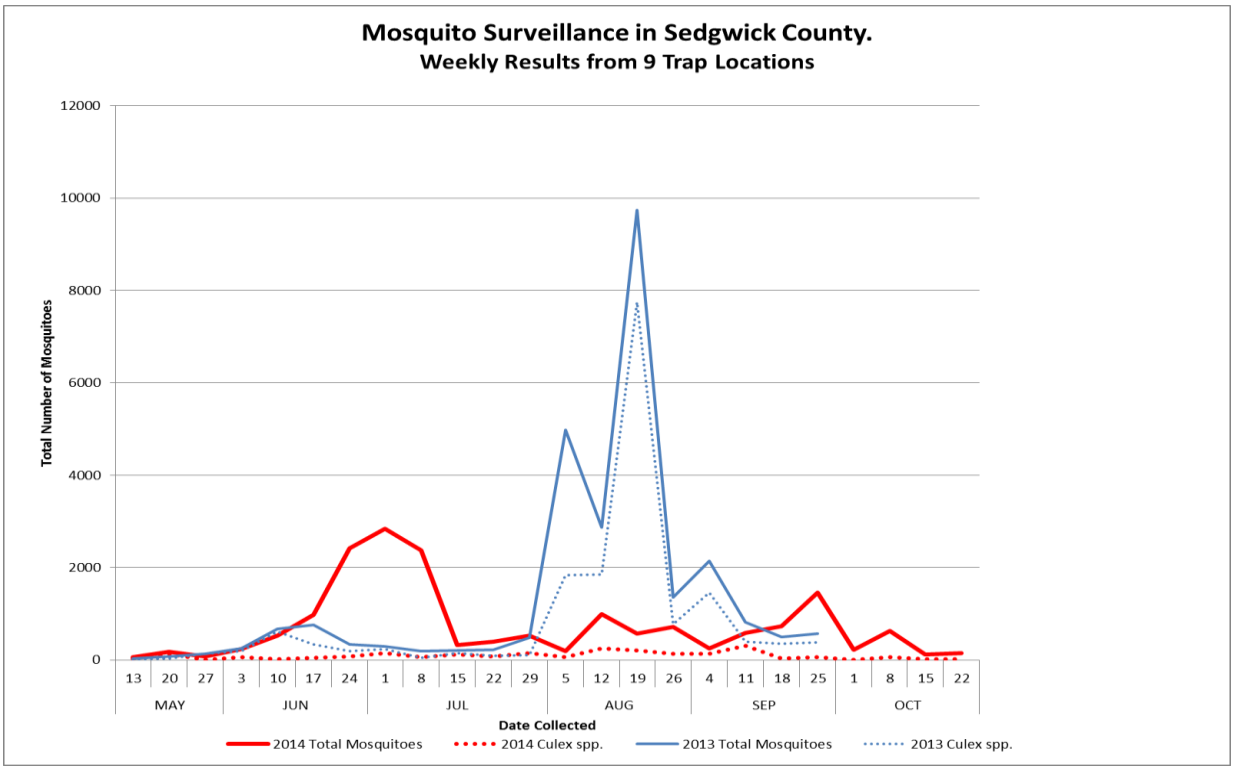
Mosquito Identification

Mosquito collection began on May 13 and continued weekly through October 21, 2014. All identified species (Table 1) have been previously documented in Kansas.

Mosquito Abundance

A trap night is calculated by taking the number of traps per week and multiplying it by the number of weeks of surveillance. There were nine trap nights per week during the twenty-four weeks of surveillance for a total of 216 trap nights. The median number of mosquitoes collected each week was 542 (range 56 – 2842) and the median number of *Culex spp.* mosquitoes was 100 (range 0 – 7744) (Figure 1). The mean number of *Culex spp.* per trap (number of mosquitoes divided by the number of traps per week) ranged from 3 – 860.

Figure 1.



There were 17,162 mosquitoes collected during 24 weeks of surveillance. The mosquito *Aedes vexans* (68%), a pest mosquito that does not transmit disease, comprised the majority of mosquitoes collected (Table 1). *Culex tarsalis* (8%) *and Culex pipiens/quinquefasciatus* (3%), both vectors for WNV, were collected at significantly lower numbers than *Aedes vexans* and accounted for a much smaller proportion of the type of mosquitoes collected compared to 2013 (Table 2).

Table 1. Mosquito species collected, Sedgwick County, 2014.

Mosquito Species	**Number**	**% Total**
Aedes vexans	11728	68
Culex tarsalis	1425	8
Anopheles quadrimaculatus	892	5
Aedes albopictus	774	5
Psorophora cyanescens	461	3
Culex pipiens/quinquefasciatus	448	3
Psorophora columbiae	381	2
Psorophora discolor	271	2
Culiseta inornata	221	1
Culex erraticus	153	1
Culex restuans	141	1
Ochlerotatus triseriatus	109	1
Ochlerotatus trivittatus	102	1
Anopheles punctipennis	25	<0.1
Psorophora ciliata	12	0.1
Oclerotatus nigromaculis	5	<0.1
Orthopodomyia signifera	4	<0.1
Uranotaenia saphirrina	4	<0.1
Psorophora horrida	3	<0.1
Ochlerotatus zoophilus	1	<0.1
Oclerotatus epactius	1	<0.1
Anopheles barberi	1	<0.1
Total	**17162**	

Table 2. Mosquito species collected by year, Sedgwick County.

	2013		**2014**	
Mosquito Species	*Number*	*% Total*	*Number*	*% Total*
Aedes vexans	6683	25	11728	68
Culex tarsalis	9458	35	1425	8
Culex pipiens/quinquefasciatus	6683	27	892	5

Arboviral Testing

Mosquitoes were pooled for testing with up to 50 mosquitoes included per vial. Mosquitoes collected on July 22 were not tested for WNV as the specimens were not suitable for testing. A total of 143 vials were tested for West Nile virus; only 1 vial tested positive (0.7%) for West Nile virus (Figure 2). The mosquitoes in the only WNV positive vial were collected on August 19. This was a substantial decrease from 2013 where 10.5% of vials were positive for WNV.

Human Case Surveillance

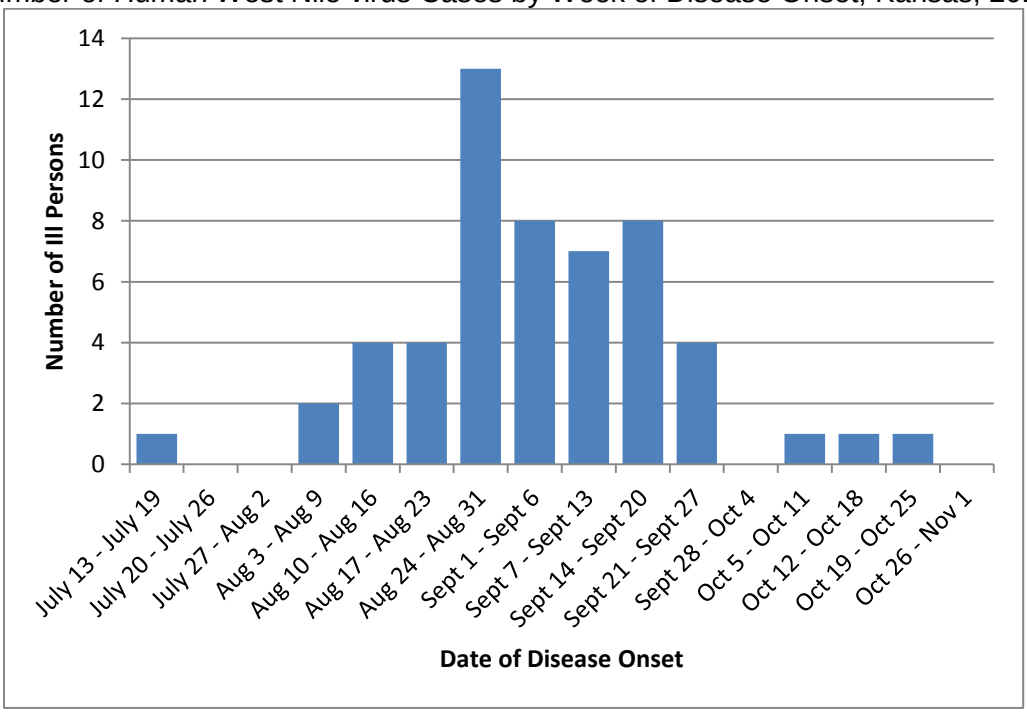
State of Kansas

A total of 54 human cases of West Nile virus were reported in the state of Kansas during 2014 (Table 3). This was a 41% decrease in cases from 2013 (n= 92). There were 36 cases of non-neuroinvasive WNV and 18 cases of neuroinvasive WNV. There was one case of non-neuroinvasive WNV and no cases of neuroinvasive WNV in Sedgwick County during 2014. The median age of case-patients was 54 years (range 10 – 78 years). Twenty-seven cases (52%) were hospitalized. No deaths were reported. The earliest case became ill in July; the majority (50%) of cases had disease onset during September (Figure 2).

Table 3. Human West Nile virus case characteristics, Kansas, 2013-2014.

	2013	2014
Number of Cases	**92**	**54**
Age (years)		
Median	59.5	54
Range	12-85	10-78
	Number of Cases (%)	
Gender		
Male	63 (68)	32 (61)
Female	29 (32)	20 (39)
Month of Disease Onset		
July	3 (3)	1 (2)
August	13 (14)	23 (43)
September	67 (73)	27 (50)
October	9 (10)	3 (6)
Clinical Status		
Neuroinvasive disease	33 (36)	18 (33)
Non-neuroinvasive disease	59 (64)	38 (70)
Hospitalized	56 (61)	27 (52)
Died	8 (9)	0

Figure 2. Number of Human West Nile virus Cases by Week of Disease Onset, Kansas, 2014.



West Nile virus Neuroinvasive Disease

The neuroinvasive case rate decreased 53% in the State of Kansas and 64% in the West North Central region (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota) from 2013 to 2014. There were no cases of neuroinvasive West Nile virus disease in Sedgwick County in 2014 compared to 4 cases in 2013 (Table 4).

Table 4. West Nile virus neuroinvasive disease count and incidence rate* by year, 2011-2014

Region	**2011**		**2012**		**2013**		**2014**	
	Count	*Rate*	*Count*	*Rate*	*Count*	*Rate*	*Count*	*Rate*
Sedgwick County	0	N/A	10	1.98	4	0.79	0	N/A
Kansas	4	0.14	20	0.69	34	1.17	18	0.62
West North Central	31	0.15	225	1.08	288	1.38	104	0.50
U.S.	486	0.16	2,873	0.92	1,267	0.40	1,347	0.42

**Number of cases per 100,000 population, based on July 1, 2013 U.S. Census population estimates.*
†U.S. Census region, West North Central includes; Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota.

Animal Surveillance

Animal Case Surveillance

There was one bird that tested positive for WNV in Sedgwick County during 2014. No other WNV positive animals were reported.

Mosquito Control

The City of Wichita deployed 600 larvicide dunks within areas of standing water that were identified as likely mosquito breeding locations based on adult mosquito surveillance. No adulticiding, or spraying for adult mosquitoes, was performed.

'Fight the Bite' educational campaign materials were developed and distributed in a variety of formats, including posters and palm cards. There were a total of 1,625 palm cards and 242 posters distributed within Sedgwick County during 2014. This is a 30% increase from the number of 'Fight the Bite' educational materials distributed during 2013[4].

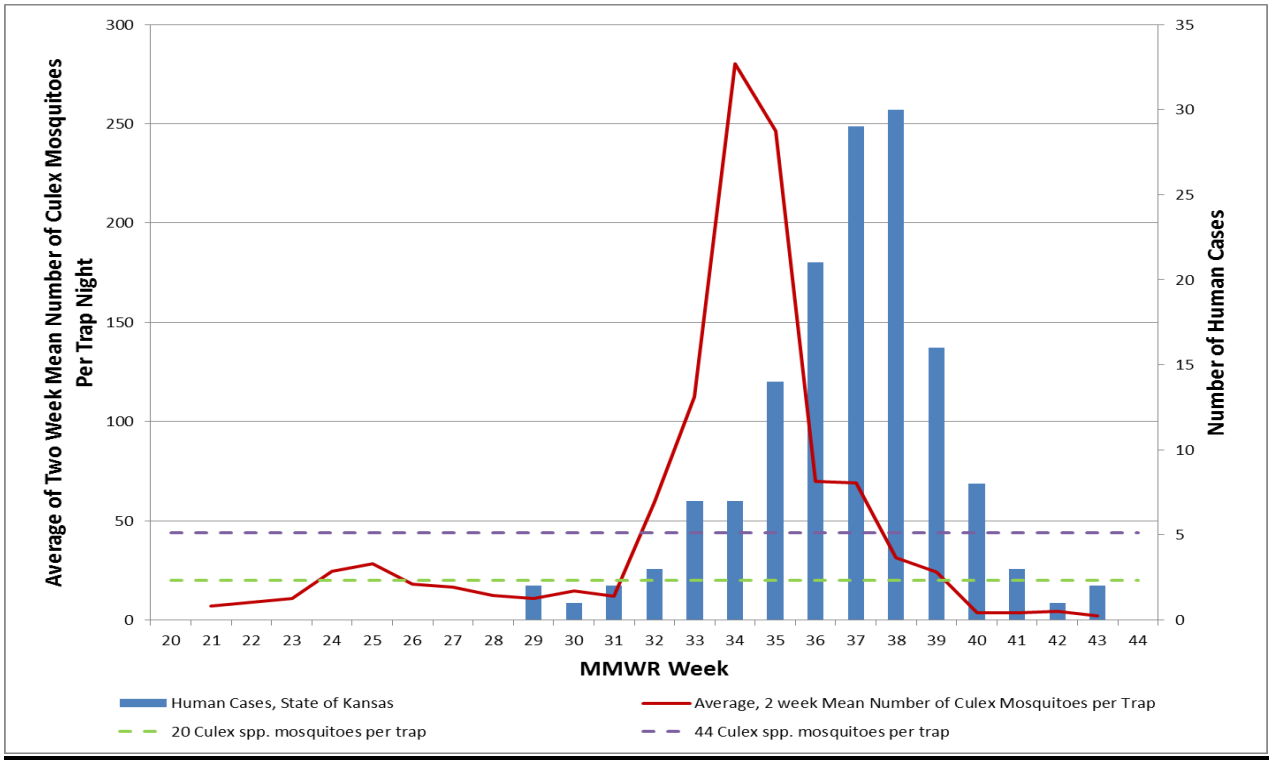
Evaluation of Measures to Predict West Nile Virus Cases

The two-week mean number of *Culex* mosquitoes was calculated and compared with the number of human cases for the entire state of Kansas that occurred in 2014, two, three, and four weeks later. There was a strong correlation between the two-week mean *Culex* prevalence and human cases that occurred in Kansas two weeks (R=0.73) later. However there was a weak correlation when we compared the two-week mean *Culex* prevalence to cases that occurred three weeks (R = 0.56) and four weeks (R = 0.48) later.

The 2013 and 2014 data was combined and the two-week mean number of *Culex* mosquitoes was compared with the number of human cases in Sedgwick County and the state of Kansas. There was a strong correlation between the two-week mean *Culex* prevalence and human cases that occurred in Sedgwick County two weeks (R = 0.82) and three weeks (R = 0.64) later. In addition there was a strong correlation between the two-week mean *Culex* prevalence and human cases throughout the entire state two weeks (R = 0.62), three weeks (R = 0.85), and four weeks (R = 0.74) later.

We evaluated the moving two-week *Culex* mosquito prevalence estimate to determine if there was a number at which the mean number of *Culex* mosquitoes could be used to guide mitigation actions. Seventy-five percent (9/12) cases occurred 2 weeks after the 2-week mean number of *Culex* mosquitoes was $\geq$44 per trap. Fifty-six percent (81/145) of cases occurred two weeks later throughout the state of Kansas when the two-week mean number of *Culex* mosquitoes per trap was $\geq$44 (Figure 5). However 81% (117/145) of cases occurred 2 weeks after the 2 week mean *Culex* mosquitoes was $\geq$20 per trap (Figure 5).

Figure 5. Two-Week Mean Culex Mosqutio Prevalence and Human Cases Two Weeks Later, Kansas, 2013-2014.



Discussion

We changed our mosquito surveillance methodology in 2013 to concentrate all of our mosquito traps in the county where the highest number of human cases had been reported each year (Sedgwick County). This allowed us to increase the number of surveillance sites in a highly populated area, increase the amount of data collected, and quantify an action level at which mosquito control efforts should occur for public health officials.

There have been several peer-reviewed papers that have evaluated the utility of mosquito surveillance data to attempt to quantify a measure or measures that can be used to predict human West Nile virus transmission from mosquitoes to humans[6-8]. Although the Vector Index is considered the gold-standard it relies on the results from West Nile virus (or other arboviruses) positive mosquitoes which can cause, at a minimum, a one to two week delay[7]. Our evaluation of the Vector Index in 2013 revealed no correlation between the VI and human cases. It does not appear that the VI is a useful measure to predict human cases of WNV in Kansas. We may re-evaluate the use of the VI when subsequent years of data are available however until then we will no longer calculate the VI.

In 2013 we discovered a strong correlation (R=0.82) between the two-week mean *Culex* prevalence and human cases occurring in Sedgwick County three weeks later. There was also a strong correlation between the two-week mean *Culex* prevalence and human cases occurring throughout the entire state of Kansas three (R=0.65) and four weeks (R=0.95) later[4]. This measure increased timeliness of the WNV surveillance data as the mosquito enumeration and identification results are usually available within 3 business days of collection. Our findings are consistent with the results of other published studies. Bolling et al concluded that abundance of *Culex tarsalis* females were strongly associated with weekly numbers of West Nile virus disease cases with onset 4-7 weeks later[7].

Drs. Kilpatrick and Pape state that use of a two- or three-week moving window of vector index would alleviate substantial week-to-week variation of the risk index[6].

The majority of cases occurred in Sedgwick County, and the entire state, two weeks after the two-week mean *Culex* prevalence was ≥44 *Culex* mosquitoes per trap night. This information can guide Sedgwick County and the City of Wichita officials on the location(s) to concentrate mosquito mitigation efforts and to focus public health messaging to residents of Sedgwick County. In addition, this information can also be used to alert all people in the state of Kansas when the risk of West Nile virus transmission may be increased.

There were at least three limitations of our study. First, we do not know the exact location where the cases were infected. For the purpose of this study we assume that the case was infected in their county of residence. This may under or overestimate the number of cases in Sedgwick County. Second, we were only able to evaluate two years of data as the sampling methodology changed between 2012 and 2013. Finally there was substantial variation in the proportion of *Culex spp.* mosquitoes between 2013 and 2014. Additional years of data are needed to understand variations in mosquito surveillance composition and the effects of transmission of West Nile virus among humans in Sedgwick County.

West Nile virus has been endemic in Kansas since 2003 with annual cases declining until the nationwide outbreak in 2012. From 2012-2013, the number of neuroinvasive West Nile virus cases decreased 83% in the United States; however, Kansas had a 70% *increase* in cases. While Sedgwick County has reported the highest number of cases of neuroinvasive disease in the state, there was a substantial (60%) *decrease* of the number of cases reported from 2012-2013. From 2013-2014, neuroinvasive WNV cases decreased to zero in Sedgwick County. Although neuroinvasive WNV cases decreased in Kansas in the same time frame, the rate was still higher than pre-outbreak rate (Table 4). We believe that the decrease in Sedgwick County is due, in part, to the targeted larvicidal treatment of mosquito breeding sites identified through adult mosquito surveillance efforts and educational outreach. Further evaluation is needed to quantify these interventions.

Outbreaks of arboviruses, such as West Nile virus, are difficult to predict due to the variety of factors that can influence transmission of this disease including weather (e.g. precipitation and temperature, animal and human host abundance, and human behaviors (e.g. use of repellent, outdoor activity, etc.)[7].

People should take the following precautions to protect against West Nile virus:

- When you are outdoors, use insect repellent containing an EPA-registered active ingredient on skin and clothing, including DEET, picaridin, oil of lemon eucalyptus, or IR3535. Follow the directions on the package.
- Many mosquitoes are most active at dusk and dawn. Be sure to use insect repellent and wear long sleeves and pants at these times or consider staying indoors during these hours.
- Make sure you have good screens on your windows and doors to keep mosquitoes out.
- Get rid of mosquito breeding sites by emptying standing water from flower pots, buckets and barrels. Change the water in pet dishes and replace the water in bird baths weekly. Drill holes in tire swings so water drains out. Keep children's wading pools empty and on their sides when they aren't being used.

References

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Appendix A: West Nile virus surveillance case definition, 2014

CLINICAL CRITERIA FOR SURVEILLANCE PURPOSES

Neuroinvasive disease

- Fever (≥100.4°F or 38°C) as reported by the patient or a health-care provider, ***AND***
- Meningitis, encephalitis, acute flaccid paralysis, or other acute signs of central or peripheral neurologic dysfunction, as documented by a physician, ***AND***
- Absence of a more likely clinical explanation.

Non-neuroinvasive disease

- Fever (≥100.4°F or 38°C) as reported by the patient or a health-care provider, ***AND***
- Absence of neuroinvasive disease, ***AND***
- Absence of a more likely clinical explanation.

LABORATORY CRITERIA FOR SURVEILLANCE PURPOSES

- Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, CSF, or other body fluid, ***OR***
- Four-fold or greater change in virus-specific quantitative antibody titers in paired sera, ***OR***
- Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen, ***OR***
- Virus-specific IgM antibodies in CSF and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred, ***OR***
- Virus-specific IgM antibodies in CSF or serum.

SURVEILLANCE CASE DEFINITIONS

- *Confirmed:*

  Neuroinvasive disease

  A case that meets the above clinical criteria for neuroinvasive disease and one or more the following laboratory criteria for a confirmed case:

  - Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, CSF, or other body fluid, ***OR***
  - Four-fold or greater change in virus-specific quantitative antibody titers in paired sera, ***OR***
  - Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen, ***OR***
  - Virus-specific IgM antibodies in CSF and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred.

Non-neuroinvasive disease

A case that meets the above clinical criteria for non-neuroinvasive disease and one or more of the following laboratory criteria for a confirmed case:

- Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, CSF, or other body fluid, ***OR***
- Four-fold or greater change in virus-specific quantitative antibody titers in paired sera, ***OR***
- Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen, ***OR***
- Virus-specific IgM antibodies in CSF and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred.

- *Probable:*

Neuroinvasive disease

A case that meets the above clinical criteria for neuroinvasive disease and the following laboratory criteria:

- Virus-specific IgM antibodies in CSF or serum but with no other testing.

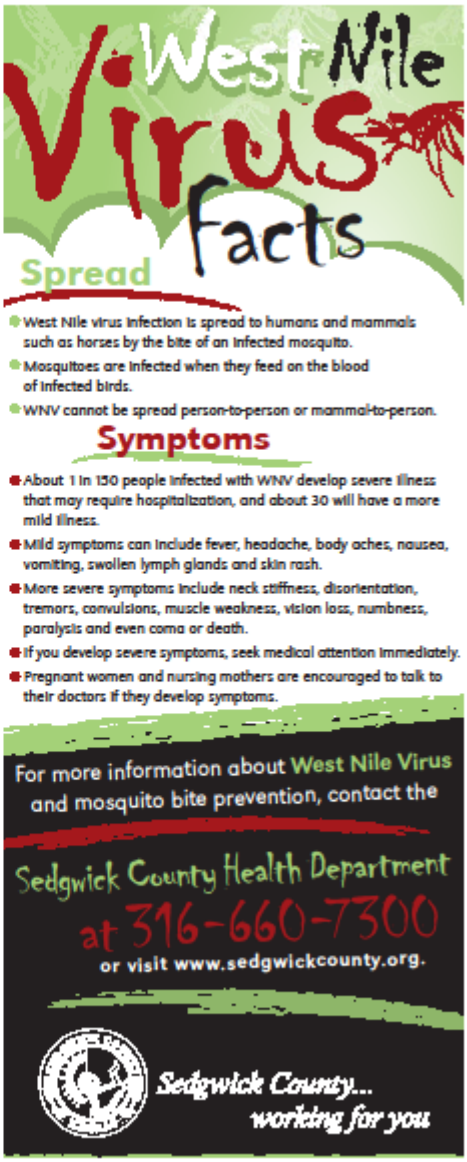
Non-neuroinvasive disease

A case that meets the above clinical criteria for non-neuroinvasive disease and the laboratory criteria for a probable case:

- Virus-specific IgM antibodies in CSF or serum but with no other testing.

Appendix B: Sedgwick County Health Department, 'Fight the Bite' Palm Card


Fight the BITE!
Mosquitoes are annoying.
They can also cause serious health problems. These tiny insects spread diseases like West Nile Virus to humans and heartworms to our pets.
The best way to avoid bites from these little suckers is to follow the three Ds:
DRAIN
Eliminate standing water; mosquitoes need water to breed. Check pots, gutters, tires, tarps, wagons, wheelbarrows – anything that holds water. Change any standing water in wading pools, pet dishes and bird baths several times a week. And, use mosquito dunks or mosquito-eating fish in ponds and stagnant water.
DEET
Use insect repellents that contain DEET. DEET offers the best protection against mosquito bites. Follow product label directions. Avoid over-application.
DRESS
Wear long, loose-fitting clothing when outdoors, especially at dawn and dusk hours, which is when mosquitoes are most active.


West Nile Virus Facts
Spread
West Nile virus infection is spread to humans and mammals such as horses by the bite of an infected mosquito.
Mosquitoes are infected when they feed on the blood of infected birds.
WNV cannot be spread person-to-person or mammal-to-person.
Symptoms
About 1 in 150 people infected with WNV develop severe illness that may require hospitalization, and about 30 will have a more mild illness.
Mild symptoms can include fever, headache, body aches, nausea, vomiting, swollen lymph glands and skin rash.
More severe symptoms include neck stiffness, disorientation, tremors, convulsions, muscle weakness, vision loss, numbness, paralysis and even coma or death.
If you develop severe symptoms, seek medical attention immediately.
Pregnant women and nursing mothers are encouraged to talk to their doctors if they develop symptoms.
For more information about West Nile Virus and mosquito bite prevention, contact the
Sedgwick County Health Department
at 316-660-7300
or visit www.sedgwickcounty.org.
Sedgwick County... working for you

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Our Mission

To protect and improve the health and environment of all Kansans